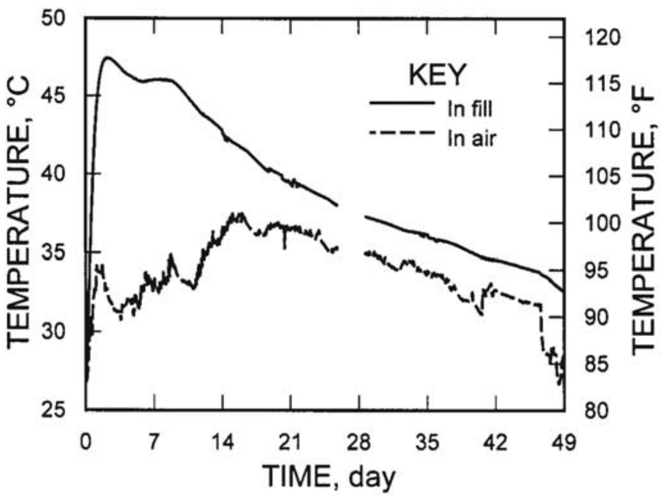

Figure 16.—Temperatures recorded on rock bolts in backfill and in mine atmosphere.

Figure 17.—Load cells at truss four-way bracket.

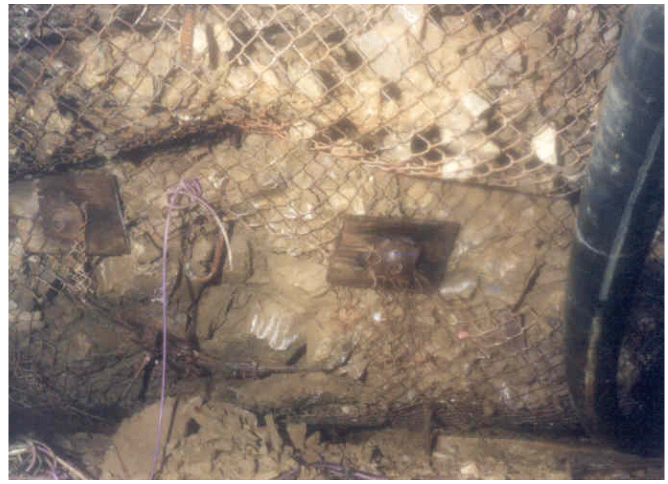

Figure 18.—Backfill failure at four-way bracket.

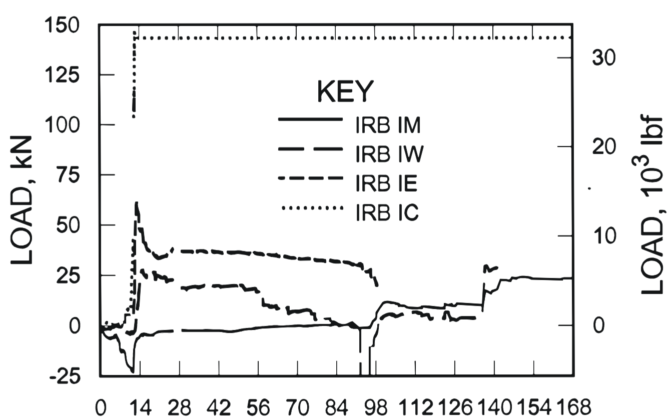

Figure 19.—Data from instrumented bolts in truss.

Table 4.—Pressure readings on truss and rock bolts during intersection failure.

Instrument	February 28, 6:00 p.m.		March 1, 6:00 a.m.		March 1, 6:00 p.m.	
	kN	lb	kN	lb	kN	lb
Load cells:						
IS truss	46.7	10,489	53.7	12,075	13.6	3,064
IM truss	42.4	9,533	50.2	11,288	2.9	644
IW truss	62.7	14,095	81.8	18,398	165	37,067
IE truss	104	23,485	114	25,584	180	40,539
IC truss, vertical	89.6	20,144	75.4	16,943	2.9	650
Instrumented bolt:						
IM truss	10.0	2,242	12.4	2,783	17.1	3,847
IW truss	6.9	1,555	17.4	3,911	29.2	6,558
Load cell on vertical bolt:						
W1	33.7	7,578	29.2	6,560	23.7	5,321
W2	13.0	2,920	8.3	1,875	8.5	1,908

CONCLUSIONS

An extensive instrumentation project carried out in the intersection area of cut 8 of the 05 stope on the 5660 level of the Lucky Friday Mine showed that the intersection truss installed to provide additional support did not function fully because closure across the vein reduced the effectiveness of the horizontal truss legs in the slot and muck bay. Data from the instruments indicated that wall closure induced loads in the truss legs parallel to the vein and in the vertical rock bolts, but that insignificant support was supplied by the truss legs perpendicular to the vein. Therefore, the mine staff decided to use an alternative support system of wood beams and posts to ensure the safety of miners working beneath the backfill.

Project data also showed that some rock bolts placed vertically in the backfill for reinforcement were taking loads past their yield strength of 160 kN (36,000 lb). This is the first documentation of mining-induced loads on rock bolts in backfill at the Lucky Friday Mine. The instruments also documented for the first time significant closure across the slot and an almost total lack of wall rock movement in the muck bay. All instruments recorded changes as mining of subsequent cuts passed by the instrument locations.

An interpretation of the interaction among wall closure, backfill deformation, and induced loads in the vertical rock bolts in the cemented backfill is presented in figure 15 and indicates how the reinforced backfill support system may work. This knowledge is important for designing backfill support systems for other mines to ensure the safety of miners working in underhand stopes.

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Clyde Peppin, chief engineer at the Lucky Friday Mine, purchased instruments and coordinated activities at the mine. Doug Bayer, rock mechanics engineer, helped install the instruments and supplied information on mining sequences. Frank Reed, mine production foreman, was very patient and helpful when researchers were working around the miners in the stope.

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APPENDIX A: RESULTS OF UNCONFINED COMPRESSION TESTS OF BACKFILL

Sample designation	Type of sample	Date of placement	Location
A	Cored	Jan. 14, 1997	5660-05 ramp-stope intersection cut
B	In situ	Mar. 11, 1997	5660-05 east (left) side of stope cut
C	In situ	Oct. 10, 1997	5660-05 ranp-stope intersection cut
D	Cored		5500-01 ramp stope intersection cut

Specimen series	Curing time, days	Compressive strength, psi			
		Average	Range		Coefficient of variation, %
			Minimum	Maximum	
Sample type A:					
1	43	628.7	577.5	685.1	5.3
2	45	632.0	571.2	694.9	6.4
Sample type B:					
1	14	450.6	414.3	477.4	5.7
2	28	499.8	469.2	530.3	4.8
3	90	613.2	575.4	698.0	7.4
Sample type C:					
1	7	302.8	247.7	398.8	18.0
2	28	472.4	385.7	556.2	14.7
Sample type D:					
1	?	249.6	241.3	263.1	3.4

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